ATTACHMENT 5. WORK PLAN

PROJECT 1-GROUNDWATER QUALITY MONITORING PROGRAM

Scope of Project

The scope of the Groundwater Quality Monitoring Program (Program) will consist of developing and implementing a plan to monitor select existing wells within the Basins for certain groundwater quality constituents. This data will be incorporated into a regularly updated Groundwater Data Management System that will be integrated with a Geographical Information System (GIS). Additional supporting data will be collected, analyzed, and inputted into the system as well. The scope of the Program will be achieved through a number of specific work tasks described in this work plan.

Goal and Objectives

The goal of the Groundwater Quality Monitoring Program is to improve groundwater quality monitoring and protect groundwater used for drinking water supply with an emphasis on water quality constituents of concern (in particular nitrates) within the Basins. The Program is expected to result in significant amounts of new knowledge and an achievable improvement in groundwater management in the Tehachapi area.

The objectives of the GWQMP are:

- To establish the baseline groundwater quality of the Basins;
- To determine the significant trends in groundwater quality;
- To identify sites for multi-level monitoring wells to be constructed in the future;
- To obtain sufficient groundwater nitrate samples from wells to prepare a future nitrate transport model to predict changes in nitrate levels resulting from the effects of various land use activities and sources of contamination;
- To obtain supporting hydrologic, water use, and other data for future groundwater modeling efforts including the development of the nitrate transport model;
- To disseminate water quality data to DWR, local agencies, and the public in summary reports, maps, and other media formats;
- To provide a planning tool to assist in decision making regarding the location of future water supply wells and water treatment needs.

Work Items

The work plan for the project is described below, and the seven work tasks are consistent with the schedule and budget.

Task 1 Develop Groundwater Data Management System

Subtask 1.1 Build Groundwater Database

A database structure will be developed to utilize existing groundwater data and allow for inclusion of additional information. Development of the database will allow for integration of existing data from multiple sources, entry of new data, and creation of summary reports and graphics. This database will be structured to link to the proposed GIS but will work as a stand-alone data retrieval database, allowing District staff without GIS software to enter data and retrieve reports. Groundwater data will be formatted to meet the needs of the Program, as well as have the capability to integrate with the GAMA Program. To develop the database, the developer will:

- Determine necessary data requirements for the database.
- Create data entry screens and background processes for quality assurance.
- Create reporting templates to summarize the data in tables and graphics, such as time-series plots of nitrates and other contaminants.
- Perform quality control checks on the database to ensure proper operation and test with sample data.
- Deploy database for data entry.

Subtask 1.2 Build GIS

The GIS will be developed in conjunction with the groundwater database. A base map of layers will be created for mapping purposes. The GIS will be linked directly to the database to prevent duplication of data. Documents such as well construction logs and photographs can be scanned and linked to the GIS, which will allow for easy retrieval by selecting the desired object in the GIS. To develop the framework for the GIS, the developer will include parcel data, agency boundaries, District facilities, and other pertinent layers in the system. Data that is collected and described in subsequent tasks will then be inputted into the system.

Task 1 Deliverables

1. Database with customized data entry screens and reporting templates.
2. GIS linked to the database with select layers and map templates.

Task 2 Groundwater Monitoring Well Network

Subtask 2.1 Develop Groundwater Monitoring Plan

An effective Groundwater Monitoring Plan is essential to the GWQMP to ensure consistency in monitoring efforts so that evaluations of the data are valid. Consistency should be reflected in factors such as location of sample points, sampling and testing procedures, and even time of year when the samples were taken. Without such common ground, comparisons between and among data must be carefully considered. The District will work with urban water purveyors to establish protocols that are common basin-wide in as much as possible.

The USGS *Guidelines and Standard Procedures for Studies of Ground-water Quality: Selection, and Installation of Wells, and Supporting Documentation* and other resources included in **Exhibit 5.1**. will be utilized to develop sampling protocols and reporting procedures. Reporting Templates contained in the USGS Guidelines (included as **Exhibit 5.2**) will be revised for TCCWD's purposes.

Subtask 2.2 Collect and Review Existing Well Data

The District will collect available well data and review it for inclusion in the GWQMP. Data will include locations of existing wells within the Basins, well driller logs, historical groundwater levels in wells, and available groundwater quality sampling data and reports. With the consent of the local water purveyors, groundwater quality reports will be obtained from the California Department of Public Health.

Subtask 2.3 Identify Monitoring Wells

Based on the review of the data, long-term monitoring wells will be selected in order to adequately characterize groundwater quality in the basin aquifers. This will include a review of the vertical distribution of groundwater quality by examining the perforation range and depth of the well. Based on past studies of the local area, it is expected that approximately 3 to 4 wells per square mile will be included in the Program. TCCWD will pursue the locating of monitoring

wells in the predominant agricultural areas, in areas of concentrated septic systems, in locations both upgradient and downgradient of treated wastewater effluent discharge areas, and in other key areas of hydrogeologic interest (e.g., in the vicinity of recharge basins).

Most of the production wells owned/operated by the urban water purveyors in the Basins (approximately 40 wells) will be included in the monitoring network as these wells have long-term historical water level and groundwater quality sampling available. To better characterize the vertical and horizontal distribution of groundwater quality, additional privately-owned wells will selected based on location, depth, and perforation range. For this reason it is an important requirement for any well considered for inclusion in the sampling network to have the availability of well construction details. Based on preliminary information, including localized nitrate studies of the Golden Hills area, approximately 50 private wells throughout the three basins will be included in the monitoring program. This number is expected to change as data is collected and reviewed.

This subtask will also include the identification of potential sites for future multi-level monitoring wells. Due to the high costs of constructing these wells, specific sites must be selected carefully, which can be done after monitoring the proposed network for a period of time. References mentioned in **Exhibit 5.1** will be used to help determine these locations.

Subtask 2.4 Obtain Agreements

To obtain access for TCCWD to monitor the water level and water quality of private wells, a Right-of-Entry agreement will need to be authorized by the well owner. A template of the agreement form is included as **Exhibit 5.3**. Historically, property owners have been cooperative in assisting the District in monitoring efforts and are expected to comply with these requests. Well owners are typically interested in determining the suitability of the groundwater quality of their well and would like to receive the results of the water quality tests. However, if certain well owners do not wish to have their well monitored, there are multiple wells throughout the basin with locations near the targeted areas that would have similar characteristics. Owners of these wells could then be approached for obtaining access for monitoring. **Exhibit 5.4**, a map from the Tehachapi Basin Groundwater Study (Fugro, 2008), shows the large number of wells within the basin.

Each of the CSDs and the City of Tehachapi has expressed support of the project and their willingness to share groundwater quality and other data for inclusion in the GWQMP (see **Exhibit 4.8**).

Subtask 2.5 Conduct Additional Groundwater Quality Monitoring

Wells owned by the water purveyors will continue to be monitored by trained staff at the CSDs, City, and mutual water companies, and data will be provided to TCCWD for entry into the database. Private wells will be sampled by District staff and tested by a certified water quality testing laboratory. All sampling will be conducted by appropriate professionals, maintained with required preservatives under proper chain of custody procedures, and transported to the certified lab within proper holding times. It is expected that samples will need to be tested monthly for the first three months as the monitoring network is developed in order to create a network that adequately characterizes the horizontal and vertical distribution of nitrate concentrations. Initial monitoring will focus on nitrate sampling and testing. Other water quality constituents of concern will be tested if further investigation is warranted based on the research conducted in Subtask 2.2.

Task 2 Deliverables:

1. Groundwater Monitoring Plan
2. Well attributes and monitoring data inputted into database and summarized in report templates.
3. Map of monitoring wells with select attributes displayed (e.g. casing size, depth, perforated interval, etc.). Well information forms developed and included in the Groundwater Monitoring Plan will be utilized for selected monitoring well sites.
4. Right-of-Entry Agreements with private well owners. Copies of the agreements will be integrated into the database for record keeping.

Task 3 Wastewater Treatment Facility Monitoring

Subtask 3.1 Collect and Review Data

To accurately account for the nitrogen loading of wastewater treatment facilities (WWTF) in the Basins, the Groundwater Data Management System will be used to keep track of historical wastewater effluent disposal data. For each facility, data is currently collected by the facility operators, including daily discharge volumes, monthly water quality analyses of the nitrogen components of the effluent, and location and volume of effluent applied to crops. This data will be obtained from the operators and included in the database.

Task 3 Deliverables:

1. Effluent disposal and monitoring data inputted into Groundwater Data Management System.

Task 4 Estimation of Nitrogen Loading from Septic Systems and Agricultural Lands

The other major sources of nitrates in the groundwater are from septic systems and agricultural lands. Because direct monitoring of nitrogen levels in soils beneath septic systems and agricultural lands are both labor and cost intensive, existing studies will be reviewed and applied to local conditions to determine approximate estimates of nitrogen loading.

Subtask 4.1 Collect and Review Septic System Data

Available data from local agencies will be obtained and reviewed. This data will include types and locations of septic systems (e.g. seepage pits versus leech lines), approximate age of septic systems, typical indoor water use; this data will be entered into the database. Typical indoor water use will be determined by obtaining water use records for winter months (minimal outdoor water use) based on the zoning of parcels in order to aggregate the nitrogen loading by groups. Soil data will be retrieved from the NRCS Soil Survey and reviewed.

Subtask 4.2 Review Existing Studies and Estimate Septic System Nitrogen Loading

Based on this information collected in Subtask 4.1, estimates of nitrogen loading will be determined based on available research. A recent study in Nevada estimated the nitrogen loading from septic systems by utilizing field collected samples and calculations using the Hantzsche and Finnemore equation (Rosen et al., 2006). This research will be applied to the Tehachapi area using local climate and indoor water use data. Data generated will be entered into the database and integrated into the GIS system. A map of the basins will be generated to show the types of approximate estimates of nitrogen loading from septic systems. In the future as additional development occurs and/or septic system management practices change, the database can be modified as needed.

Subtask 4.3 Obtain Crop Data and Prepare Crop Map

District staff will perform a drive-by survey of the irrigated lands to determine current cropping and irrigation system by field. The data will be inputted into the database and shown graphically by a crop map. The database will be developed so that crop and irrigation system data can be inputted by District staff, allowing for future annual updates to be made efficiently.

Subtask 4.4 Conduct Interviews of Local Farm Managers

Interviews of local farm managers will be conducted to better understand current and historical nutrient and water management practices categorized by crop. Fertilizer application rates are necessary for determining to what extent over-application of nitrogen occurs. Water management practices, including estimates of irrigation efficiency and distribution uniformity are needed to assess the movements of nitrates downward through the soil profile.

Information obtained from these interviews will be compared to reported values from existing studies. UC Davis Agricultural & Resource Economics (ARE) crop cost and return studies and USDA Chemical Usage Reports will be referenced for typical fertilizer usage. Based on the type of irrigation system, typical irrigation efficiencies obtained from the literature (Hanson, 1995) will be included in the database.

Subsequent to the interviews, water and nutrient management literature will be provided to the farm managers to make them aware of practices for preventing nitrate contamination. An extensive discussion of these recommendations is included in the recent UC Davis study, *Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality* (Dzurella et al., 2012).

Subtask 4.5 Review Existing Studies and Estimate Nitrogen Loading by Crop

Nitrogen loading will be estimated by using information from available studies, crop acreage estimates from TCCWD, and knowledge of local nutrient management practices. The recent UC Davis study, *Technical Report 2: Nitrogen Sources and Loading to Groundwater* (Viers et al., 2012) has multiple resources for analysis of nitrogen loading by crop. Utilizing this data, mass balance calculations can be performed to determine estimates of nitrate leaching into the groundwater.

Task 4 Deliverables:

1. Memorandum summarizing the assumptions and data obtained related to nitrogen loading of septic systems.
2. Map representing geospatial data related to septic systems.
3. Crop map for 2013. Total crop acres by irrigation system will be summarized on the map.
4. Memorandum summarizing the investigation of nutrient management practices and nitrogen loading of agricultural lands.

Task 5 Other Supporting Data

Other supporting data, consisting of climate, surface water use by turnout, and recharged water data, will be collected and maintained within the database. These parameters are important for use as input data for future modeling of the groundwater aquifers and subsequent development of contaminant transport modes.

Subtask 5.1 Collect Climate Data

Climate data that will be collected and maintained in the database consists of precipitation, temperature, pan evaporation rates, and reference evapotranspiration. This data will be obtained from the weather stations in the region and from rainfall gauges monitored by TCCWD. This data is needed for estimating recharge from precipitation as well as recharge from ponds through water balance calculations. This data will also be used for determining nitrogen loading from septic systems and farming as components in the water balance calculations.

Subtask 5.2 Collect Water Use Data

Water use data, including SWP water deliveries by turnout and groundwater extractions by well, will also be necessary for future groundwater modeling efforts. Currently, the District keeps track of water use data in individual spreadsheets; this data will be included in the database so that it can be better utilized for future analyses. Turnout deliveries will be linked to the District facilities GIS layer, which will be useful for geospatial analysis using GIS tools. Groundwater pumpage will also be integrated into the GIS well layer, which will allow for the District to efficiently view all details related to a well in one location (including historical groundwater levels and pumpage, water quality, well and pump attributes, well construction log, etc.).

Subtask 5.3 Collect and Analyze Recharge Water Volumes

Additional data will be collected in regards to recharge water used for conjunctive use projects. This data collection will include weekly (daily in some cases) estimations of wetted area and water depth to more accurately determine water percolated into the ground. Water balance calculations will be prepared for this data that can be used to determine the volume of water recharged into the aquifer. The data entry form will be customized so that District staff can input the select data, and the calculations will be performed automatically.

Task 5 Deliverables:

1. Climate, water use, and recharge water data inputted into Groundwater Data Management System. Report templates with annual summaries of data will be developed.

Task 6 Annual Monitoring Report

Subtask 6.1 Prepare First Annual Monitoring Report

The first Annual Monitoring Report will be prepared and include summary tables, maps and graphical representation of the data collected, a description of the data collected, conclusions, and recommendations for future monitoring tasks. Specifically the report will contain:

- Description of Program and the year's activities;
- Water Use (imported water and groundwater) tables and figures;
- Map of monitoring wells with select data shown;
- Recharge water volume tables and figures;
- Crop Map and table with acreages;
- Time-series of Nitrate concentrations and hydrographs of select wells;
- Climate data tables and figures;
- WWTF data tables and figures;
- Estimates of nitrogen loading tables and figures;
- Recommendations for Program improvements, including discussion of additional wells to be monitored.

The tables, maps and figures representing the data will be setup as templates to allow for the District to prepare annual updates with minimal additional work besides inputting the data for the current year. Annual Monitoring Reports will be submitted to other local water agencies and will be available at the District's office for public review.

Task 6 Deliverables:

1. First Annual Monitoring Report.

Task 7 Reporting and Stakeholder Involvement

Subtask 7.1 Prepare Quarterly Progress Reports to DWR

The District will submit required quarterly progress reports to DWR. These reports will discuss progress to date, data developed, tasks to be completed during the next quarter, costs incurred, and problems encountered. Any deliverables generated during that period will also be included with the report. Each report will be prepared in accordance with the required DWR format. Progress reports will also be provided at TCCWD Board of Directors meetings and WAPC meetings.

Subtask 7.2 Prepare Final Report to DWR

The Final Report will include a copy of the first Annual Monitoring Report along with other data and maps generated through this project. A description of work completed, recommendations for future data collection and analysis, and how the budget was utilized will be included in the Final Report. A comparison between the planned schedule in the Agreement and actual timeline of completed tasks will be prepared along with a discussion of major problems encountered and how they were resolved. This report will also include other deliverables as described above along with the supporting datasets.

The Final Report will be submitted to DWR for review. If DWR has any comments related to the report, these will be addressed, and the report will be resubmitted to DWR. TCCWD will submit copies of the Final Report to DWR in the quantities requested. The Final Report will also be available at the TCCWD office for public review.

Subtask 7.3 Updates on TCCWD's Website

Periodically, as shown in the schedule, TCCWD's existing website will be updated with information related to the Program. The update will have a short description of the project and select data generated from the program will be available for the public to review. The District will also include a PDF copy of the Annual Monitoring Report on the website for public access.

Subtask 7.4 Meetings and Workshops

TCCWD will also provide status updates of the Program at WAPC and TCCWD Board of Directors meetings, as shown in the schedule. Additionally, at two WAPC meetings early on in the project, workshops will be help to obtain input from local agencies and the public on the data collection process and discuss results of the initial work.

Subtask 7.5 CEQA Compliance

The projects as described are for informational purposes only and do not involve any construction; therefore, they are exempt from CEQA. TCCWD will therefore claim a Class 6 'Information Collection' exemption (Section 15306). At the start of the project, a notice of exemption will be prepared and approved by the TCCWD Board of Directors and filed with Kern County. Copies of the CEQA document will be submitted to DWR.

Task 7 Deliverables:

1. Website updates
2. Quarterly progress reports to DWR
3. CD of the Groundwater Data Management System and GIS files
4. Final Report to DWR
5. Meeting minutes from WAPC workshops.
6. CEQA compliance document.

Consistency with Groundwater Management Program and IRWMP

The Work Plan as outlined is consistent with the goals and objectives of the Court Judgments and the GTASCP as discussed in **Attachment 4**.

The TCCWD is part of the Tulare Lake Basin Portion of Kern County Region Integrated Regional Water Management Plan (Kern IRWMP). The Kern IRWMP was finalized in November 2011 and can be found on the Kern IRWMP website (http://www.kernirwmp.com/documents.html). The Kern IRWMP describes the water quality issues in the Tehachapi area:

> The most common contaminant found at higher than desirable concentrations within the Tehachapi Basin, Cummings Basin, and the Cuddy Valley Basin is nitrate. High levels of nitrate within these areas is a result of more than 60 years of heavy use of nitrate and ammonium fertilizers as well as secondary treated effluent from small wastewater treatment facilities and septic systems. Nitrate levels in Tehachapi municipal wells once exceeded 30 mg/L and nitrate concentrations in two other wells belonging to Ashtown, a small annexed subdivision outside of Tehachapi, once exceeded 45 mg/L (DHS 1991; Jasper 2000). (Page 5-9)

The proposed project is compatible with the Kern IRWMP in many ways. Specifically, the project is consistent with the following goals of the IRWMP:

> *Continue to provide drinking water that meets or exceeds water quality standards; and support efforts to attain appropriate standards throughout the planning horizon* (Page 10-8)
>
> *Increase educational opportunities to improve public awareness of water supply, conservation, and water quality issues throughout the planning horizon (Page 10-10)*

Project Performance by Task

Project performance will be measured as described below for the project Tasks:

Task 1 Develop Groundwater Data Management System

The data management system will be developed to meet the needs of the District and ensure that adequate data is obtained for proposed and future analyses. Input from District staff will be essential in order to create a system that is usable by the staff and generates reports that are useful to stakeholders. Review and testing of database and report templates will be performed. WAPC workshops and reviews of datasets and reports by stakeholders will be used to guide the further development of the system.

Task 2 Groundwater Monitoring Well Network

The selection of monitoring wells will be performed by the District's consultant. Third party QA/QC reviews of the monitoring well network will be performed by the groundwater modeling consultant to ensure that the network provides an adequate characterization of the horizontal and vertical distribution of groundwater quality in accordance with requirements of the future transport model. This review is included in the budget (see **Exhibit 6.1**). The District's consultant will review with District staff the proper procedures of groundwater sampling, including QA/QC field reviews of sampling performed by District staff.

Task 3 Wastewater Treatment Facility Monitoring

The District's consultant will provide QA/QC reviews of data collected to ensure accuracy of data inputted into the database

Task 4 Estimation of Nitrogen Loading from Septic Systems and Agricultural Lands

Third party QA/QC reviews of the nitrogen loading estimates and assumptions will also be performed by the groundwater modeling consultant to ensure accurate determinations are made.

Task 5 Other Supporting Data

The District's consultant will provide QA/QC reviews of data collected to ensure accuracy of data inputted into the database.

Task 6 Annual Monitoring Report

The Annual Monitoring Report will be reviewed by the engineering consultant, District staff, water agencies (through the WAPC), and Board of Directors. This will help ensure the reports are well organized, contain relevant information, and contain an appropriate level of detail.

Task 7 Reporting and Stakeholder Involvement

Public outreach efforts and stakeholder involvement will be evaluated based on the involvement of people and agencies, and comments received. Useful comments will be incorporated into the projects. Progress and final reports to DWR will be reviewed similar to Task 6. No performance issues are expected in regards to CEQA compliance.

PROJECT 2-CUMMINGS BASIN GROUNDWATER MODEL UPDATE

Scope of Project

A numerical groundwater model was prepared about ten years ago for the Cummings Groundwater Basin (Basin) and covered a base period from 1981 to 2001. Since that time period, multiple changes to water use and land use have occurred and additional data has been collected that can refine gross assumptions that were made during the preparation of the previous model.

The project will consist of collecting and organizing data from October 2001 through September 2011 that will be used to estimate the recharge and discharge water balance components. The original model will be updated and a post-audit will be performed by implementing the water balance components into the new model and simulating the groundwater levels in the Basin over this period. The task of re-calibration will include steady-state and transient calibration of the model to historical groundwater levels, pumping, and recharge beneath the Basin. A report will be prepared that presents the compiled data and the findings of the study, including discussion of the re-calibrated numerical groundwater model. The scope of the Program will be achieved through a number of specific work tasks described in this work plan.

Goals and Objectives

The objectives of the project are to update the existing Cummings Basin groundwater model with the past ten years of data and calibrate the model so that the District can assess the current condition of the Basin. The goal of this effort is to provide TCCWD with a tool to enhance the District's ability to manage and protect the groundwater resource in the Cummings Valley. Analysis of potential impacts resulting from changes in water production, new development and land use will be addressed in subsequent work. This Project is the first step in the overall assessment of the Cummings Groundwater Basin and will be used to improve groundwater management.

Work Items

The work plan for the project is described below, and the four work tasks are consistent with the schedule and budget.

Task 1 Collection/Compilation of Recent Data

Task 1 will consist of the collection and organization of the same kinds of required data from October 2001 through September 2011 as was collected originally by Fugro for the base period of 1981 to 2001. This data will include groundwater elevations, aquifer tests, any additional geologic logs, precipitation records, well pumping records, imported water use, recharge, WWTF records, cropping and land use maps. This data will be collected from local agencies and cooperating landowners.

Task 1 Deliverables

1. Tables and figures summarizing data.

Task 2 Water Balance Estimation

Task 2 will consist of estimating the recharge and discharge water balance components identified in the original study from October 2001 through September 2011.

With the data collected in Task 1, a hydrologic balance can be estimated from October 2001 to September 2011. This period will then be combined with the original base period of October 1981 to October 2001 to form a new base period. Annual changes in groundwater storage will be estimated in the hydrologic balance as the difference between total annual aquifer recharge and total annual aquifer discharge. The major sources of groundwater recharge components that will be estimated include:

1. Subsurface inflows through the Basin alluvium boundary;
2. Deep percolation of direct precipitation;
3. Deep percolation of precipitation runoff in intermittent streams;
4. Artificial recharge of SWP water in conjunctive use programs;
5. Deep percolation of irrigation return flows; and
6. Recharge of discharged wastewater effluent.

The major groundwater discharge components are:

1. Subsurface outflows through the Basin alluvium boundary;
2. Urban/M&I groundwater pumping;
3. Rural domestic groundwater pumping; and
4. Agricultural groundwater pumping.

The development of the numerical groundwater model requires the spatial distribution of these recharge and discharge stresses and be aggregated to the scale of the numerical model.

Task 2 Deliverables

1. Tables and figures summarizing analysis.

Task 3 Model Update, Post-Audit, and Re-Calibration

Subtask 3.1 Model Update and Post-Audit

Subtask 3.1 will consist of updating the original model and conducting a model post-audit. The model post-audit will be performed by implementing the water balance components into the original (updated) model and simulating the groundwater levels in the Basin over the period from October 2001 through September 2011. Given the volume of new data that will be inputted into the model and the cultural changes within the basin that have taken place over the past decade, it is likely that a full re-calibration will be required.

The groundwater model will be recast using MODFLOW-2005 (Modular Finite-Difference Groundwater-Flow Model), a three-dimensional groundwater flow model developed by the United States Geological Survey. A commercially available graphic user interface will be utilized for pre-processing and post-processing of model files.
Once constructed, the updated model (including the original and extended base periods) will then be executed and its simulated results checked to ensure that model convergence is successfully achieved and that the estimated recharge and discharge inputs are accurately

implemented in the model. A post-audit of the existing model will then be performed by comparing the simulated groundwater levels and stream flows against measured groundwater levels and stream flows. The purpose of a post-audit is to evaluate how well the original model is able to continue simulating water levels and flow beyond the original calibration period.

Subtask 3.2 Re-Calibration of Model

The task of re-calibration will include steady-state and transient calibration of the model to historical groundwater levels, pumping, and recharge beneath the Basin. The model will be calibrated over a multi-year period using monthly stress periods based on the patterns of change in recharge (precipitation) and/or water level observations in the Basin. The model would also be calibrated to available pumping (drawdown) tests. The accuracy of the transient calibration would be dependent on number and length of stress periods simulated and the available observation data. The calibration process would involve iterative modification of aquifer parameters and boundary conditions (within reasonable limits) in order to minimize the residual (difference) between observed and simulated heads at selected observation points. Information gained during the model calibration process would be used to refine and verify the water balance estimated for the Basin.

The objective of the model calibration is to adjust certain hydraulic parameters (e.g., horizontal and vertical hydraulic conductivity, storativity, streambed permeability) and modify selected recharge and discharge components until a reasonable match between the measured and modeled heads and flows is achieved. Calibration of the groundwater flow model will be performed according to ASTM (1996, Reapproved 2002) “Standard Guide for Calibrating a Ground-Water Flow Model Application.”

Subtask 3.3 Model Sensitivity Analysis

Once the updated groundwater model has been satisfactorily calibrated, a sensitivity analysis will be performed by evaluating the response of the calibrated model to changes in estimated hydraulic parameters or to changes in uncertain recharge and discharge components. Key parameters or components will be those that have the most significant impact on model results within their range of uncertainty. The sensitivity analysis model runs will be compared to a baseline model run of the calibrated updated model to illustrate differences in results for a given parameter or component change. The results of the calibration sensitivity analysis will be evaluated according to ASTM (1994, Reapproved 2008) “Standard Guide for Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application.”

Task 4 Report, Project Management, and Meetings

Subtask 4.1 Prepare Cummings Basin Groundwater Model Report

Following completion of Tasks 1, 2, and 3, a report which presents the compiled data and the findings of the study, including discussion of the re-calibrated numerical groundwater model, will be prepared. The sections of the report will include:

1. The basic setting of the Cummings Groundwater Basin;
2. A summary of the hydrologic and hydrogeologic data collected for the Basin;
3. Discussion of the water balance and the components of recharge and discharge;
4. The construction and calibration of the numerical groundwater model; and
5. Recommendations for future analysis.

Subtask 4.2 Meetings and Project Management

This subtask is designated for meetings and project management to be conducted by the District’s hydrogeologist. This will include initial project meetings to gather data and information

and meetings to discuss the results of the modeling efforts. Project management functions include budget management, miscellaneous correspondence, internal project meetings and other functions.

Task 4 Deliverables

1. Final Report of the Cummings Groundwater Basin Modeling Study.
2. CD of the model data including data tabulated in spreadsheets

[*Note: Stakeholder involvement, information dissemination, website updates, DWR Quarterly Progress Reports, and the DWR Final Report work items are included in Task 7 of Project 1. Information regarding the Cummings Basin Groundwater Model will be included in these work items.]*

Consistency with Groundwater Management Program and IRWMP

The Work Plan as outlined is consistent with the goals and objectives of the Court Judgments and the GTASCP as discussed in **Attachment 4**.

The Cummings Groundwater Model Update Project is also consistent with the Kern IRWMP's following goals:

> *Through cooperation and collaboration with other regions restore water supplies to levels that will mitigate for water lost from the region and eliminate overdraft (400,000 – 1MAF) (Page 10-4)*
>
> *Integrate management of water banking facilities to maximize conjunctive use over the planning horizon (Page 10-5)*
>
> *Increase/augment water supplies to meet region demands (e.g., municipal and industrial, agricultural, environmental) by 2050. (Page 10-5)*
>
> *Increase educational opportunities to improve public awareness of water supply, conservation, and water quality issues throughout the planning horizon (Page 10-10)*

Project Performance by Task

Project performance will be measured as described below for each of the four project tasks:

Task 1 Collection/Compilation of Recent Data
Meetings with TCCWD staff, WAPC workshops, and coordination with the urban water purveyors will be used to assemble the datasets. Summary tables will be generated to ensure the correct data is used for the analyses.

Task 2 Water Balance Estimation
QA/QC reviews by the project management team of the groundwater modeling consultant will be performed to ensure accurate assumptions and results.

Task 3 Model Update, Post-Audit, and Re-Calibration
Performance of the groundwater model update, auditing, and re-calibration will be performed by qualified staff with many years of experience in the numerical modeling using MODFLOW. With the highly technical nature of this project a third-party groundwater modeling expert with the engineering consultant would be used to evaluate the progress and performance of the

groundwater modeling consultant. This review is included in the budget (see **Exhibit 6.2**). Discussion of this is included in **Attachment 8**.

Task 4 Report, Project Management, and Meetings

The groundwater model report will be reviewed by the groundwater modeling consultant, the third party expert, District staff, water agencies (through the WAPC), and Board of Directors. This will help ensure the reports are well organized, contain relevant information, and contain an appropriate level of detail.

[The remaining sections apply to both Projects 1 & 2]

Strategy for Evaluating Progress and Performance

General Project Monitoring

TCCWD has developed a detailed process for project monitoring and evaluation. This process is reflected in the work plan, budget and schedule.

General Project Monitoring

Project monitoring will be performed through the following:

1. Updates on the project status at monthly District Board meetings
2. Quarterly progress reports submitted to DWR
3. Water Availability Preservation Committee meetings
4. The Annual Monitoring Report and Cummings Basin Groundwater Model Report will be available for public review and comments

These monitoring efforts will provide opportunities for the public, local water agencies, Board of Directors, District staff, and DWR to comment on the project. Involving these parties will ensure the work is proceeding in the appropriate direction and ultimately provides a product that is needed, useful and understood. Lastly, the numerous quality assurance measures outlined in **Attachment 8** will also help to ensure that the project is properly monitored and reviewed.

Management of Schedule and Budget

The budget and schedule will be reviewed weekly to measure progress versus expenditures. If expenditures are higher than anticipated, or progress is behind schedule, then the TCCWD general manager and engineering consultant will meet within a week to resolve any problems. DWR will be notified as soon as possible if there are budgetary or scheduling concerns. The schedule, however, includes some contingency so scheduling problems are considered unlikely. If schedule problems do arise then additional qualified personnel will be assigned to bring the project's timeline back on schedule.

Technical Background

The scope of work was prepared using detailed information found in the TCCWD files and the numerous technical references listed in **Exhibit 5.1**. Therefore, there is strong technical justification for the project, and the scope of work is based on documented and accepted scientific data.

Environmental Documentation and Permitting

Environmental compliance efforts are reflected in the budget and schedule.

CEQA Compliance

The projects as described are for informational purposes only and do not involve any construction; therefore, they are exempt from CEQA. TCCWD will therefore claim a Class 6 'Information Collection' exemption (Section 15306). A notice of exemption will be approved by the TCCWD Board of Directors and filed with Kern County.

NEPA Compliance

The proposed project will not use federal funds or involve federal facilities so the National Environmental Policy Act (NEPA) does not apply.

Permitting Requirements

No permits will be required for the projects.

Information Dissemination

This proposal includes a well-developed process for informing water agencies, other stakeholders, and the general public about the proposed projects. TCCWD will involve stakeholders and disseminate reports, data, and/or general information as discussed in the following subsections.

TCCWD Board Meetings

The District holds monthly board meetings that are publicly advertised and open to the public. At the beginning of each meeting, there is a public comment period where opinions or concerns may be voiced on any issue. During the course of the proposed project, regular presentations will be made at the monthly Board meetings on the project status and any important project issues.

Water Availability Preservation Committee

As mentioned previously, the TCCWD, urban water purveyors, CCI, the County of Kern, and other water professionals meet monthly at the Water Availability Preservation Committee (WAPC) to discuss water management issues for the area. At these meetings, information on the project will be shared with the group. TCCWD will describe the purpose and goals of the projects, obtain input and suggestions for the projects, and share information gathered to date.

State and Federal Agencies

In compliance with CWC 10795.19, the TCCWD will submit groundwater related data collected as part of this grant to DWR. This data will include well completion reports, state well number, well casing elevation, groundwater level data, etc.

Quarterly progress reports and final reports will be submitted to DWR. These reports will include memorandums and reports prepared, along with CDs of the datasets and numerical groundwater model.

The USGS worked in conjunction with the SWRCB in preparing groundwater quality studies in accordance with the GAMA Program. The USGS representative responsible for the Southern Sierra Nevada Study Unit will be contacted at the beginning of the project to discuss the project and goals and information and data that will be generated that can supplement the GAMA Program.

General Public

The TCCWD office is open to the public every work day and during lunch for the public's convenience. Members of the public are always welcome to talk to the District Manager or operations staff about issues and concerns. The District also has tours of the District to help educate the public regarding groundwater management through in-lieu recharge and conjunctive use.

The public are also able to view copies of reports including the Regional Urban Water Management Plan and Annual Watermaster reports at the office. In the future, Annual

Monitoring Reports and the final report of the Cummings Groundwater Model Update will also be available in the office for public review.

TCCWD's website (http://www.tccwd.com/) will be updated with general information regarding the projects. Additionally, the Annual Monitoring Report and the Cummings Basin Groundwater Model Report will be available as PDFs on the website.